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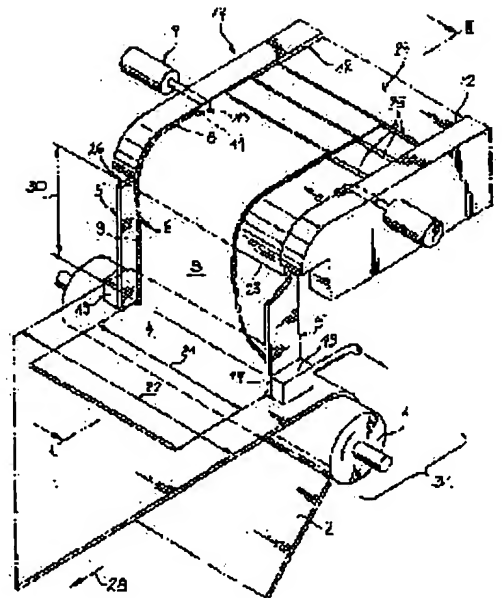
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(54) METHOD AND DEVICE FOR PERFORMING CURTAIN COATING

(57)Abstract:

PROBLEM TO BE SOLVED: To improve hanging connection between a fluid curtain and a horizontal guide and to contrive improving quality when guiding a falling curtain by feeding edge fluid having viscosity larger than that of a coating composition in a channel.

SOLUTION: In a feeder 14 as a casting device for making a falling curtain 3 of a fluid coating composition, a curtain 3 consisting of a coating composition discharged from casting slots 25 is made to fall from a casting lip 23 for coating a carrier 2. The carrier 2 is guided by a casting roller 1 and continuously conveyed in the direction of the arrow 26. At this time, the falling curtain 3 is guided by side guides 5 at side edges, however at the same time, edge fluid 8 having viscosity larger than that of the coating composition is fed in a channel from an end piece 11 of a discharge means 7, thereby minimizing the effect of disturbance by an edge.



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CLAIMS

Claim(s)

[Claim 1] In the method for carrying out curtain coating of the support by the compound for fluid coating of at least one layer The process which forms process in which this support is moved along the path passing through a coating field, and the curtain, with which the compound for fluid coating which crosses this path of this support and is extended descends, By the horizontal guide to which the edge fluid which has larger viscosity than the viscosity of this compound for coating is distributed upwards in the form of a channel The method for carrying out curtain coating of the support by the compound for fluid coating of at least one layer characterized by providing the process which guides the descending this curtain.

[Claim 2] In the equipment for having the following and carrying out curtain coating of this support by this compound for fluid coating of at least one layer This discharge means has the means for making a channel, and the means is making this edge fluid flow down each horizontal guide in the form of a channel. The viscosity of this edge fluid is equipment for carrying out curtain coating of the support by the compound for fluid coating of at least one layer characterized by being larger than the viscosity of this compound for coating. A transportation means to convey support along the path passing through a coating field. The feeder which makes the descent curtain which crosses this path of this support, and is extended, and descends on this support from the compound for fluid coating. The horizontal guide which guides this descent curtain in a horizontal edge. A discharge means to distribute an edge fluid to this horizontal guide.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the equipment for operation of the method of depending on the preamble (preamble) of a claim 2, concerning the method of carrying out curtain coating of this support by this compound for fluid coating of at least one layer in the place from which this support is moved along the path passing through the coating field where the curtain with which the compound for fluid coating (fluid coating) descends hits support (carrier).

[0002]

[Description of the Prior Art] Curtain coating is used in order to apply the silver-halide sensitive emulsion for photographs (photographic silver-halide emulsions) to support like a web in production of for example, photograph material. It is known for this coating method that the curtain (falling curtain) which descends in order that this curtain may prevent receiving the convergence (constriction) by surface tension must be guided to a longitudinal direction. The so-called horizontal guide (lateral guide) or a curtain electrode holder (curtain holder) is used for this purpose. Generally these are the fixing components of this coating equipment, consist of solid material and have the contact surface with this curtain. The speed of this fluid curtain in this contact surface is zero. This horizontal guide is a decrease on the edge (edge) of this fluid curtain. As a result, a speed profile is formed with the edge of the curtain which this descends. See this speed profile in the direction of this horizontal guide, it expresses the more and more slowdown of the rate of flow of the curtain with which it this descends, and makes weakening of this curtain cause in this edge field, and may bar the process of a laminar flow in the central field of this curtain. In the critical range of this coating process, this hanging connection between a curtain and a horizontal guide separates (breaks off). An unstable curtain separates from this horizontal guide, and, subsequently coating of this support of it becomes already impossible by convergence.

[0003] In order to prevent this slowdown of a descending speed, it is well-known to supply the fluid of an addition on the curtain which this descends with this edge. Distribution of the so-called auxiliary edge fluid or the so-called Flushing fluid (flushing fluid) of the low shear viscosity in the contact surface of this horizontal guide decreases the slowdown influence of this solid-state horizontal guide to the flow process of the curtain which this descends. This edge fluid can also be distributed by the pump and outlet opening for example, in this horizontal guide. For example, although the German patent No. 1,928,025 is indicating the horizontal guide of the hollow which has a long slot in this contact surface, the internal fluid combined with this curtain is pumped up from there (is pumped).

[0004] It has proposed using the curtain electrode holder with which the fluid of low viscosity appears from there in the direction of this curtain in the Europe patent No. 0,115,621 as compared with this curtain for stabilization of the fluid curtain which descends freely, and the fluid bridge which the aforementioned fluids are three square shapes between a curtain electrode holder and a curtain, and carries out a stabilization effect is formed in each ****.

0005] Moreover, in the case of well-known equipment, a lateral flow is supplied to this curtain on both sides by the Europe patent No. 0,740,197. Here, this fluid for Flushing is distributed on this curtain electrode holder so that the parallel flow which crosses the direction of this curtain and is extended may be formed, and although this curtain contacts only this fluid for Flushing, the curtain electrode holder of this solid-state does not contact.

0006] If it depends on the Europe patent No. 0,414,721, the fluid for Flushing will be distributed on this horizontal guide, and the aforementioned fluid for Flushing will be sucked up around the position where the descending curtain hits support (sucked away).

0007] Although the Europe patent No. 0,599,740 has proposed the curtain electrode holder which consists of the narrow wire on which the fluid for Flushing flows to the lower part in order to reduce a speed slowdown in an edge field, the aforementioned fluid for Flushing is again sucked up here, before this curtain hits this base with the edge of this curtain.

0008] All well-known methods are based on the principle which brings about the Flushing effect or a lubricous effect with the additional fluid in this edge from the conventional technology. This fluid for Flushing is reducing the influence of a slowdown on the curtain with which a solid-state curtain electrode holder's this descends. Therefore, an auxiliary fluid the viscosity is lower than that of this compound for coating is used chiefly.

0009] However, it turns out that the flow on the horizontal guide of these hypoviscosity auxiliary fluids is not steady. It is not steady and this flow that is not a laminar flow serves as a source of disturbance for a free-fall curtain. The hanging connection between a curtain and a horizontal guide does the detached building navel of the *****, and it is led to poor coating. Especially the thin fluid curtain is sensitive. This is a fault especially when using the curtain coating method for photographic-film production. In such a case, its best is done in applying uniformly to support the compound for coating which has curtain descent of the possible maximum height by the reason for economical, and is viscous by the low rate of flow. The unsteady flow in this edge restricts the processing speed at the time of coating.

0010] The purpose of this invention is offering the method and equipment for curtain coating which descends without improving the hanging connection between a fluid curtain and a horizontal guide, and receiving only the fewest disturbance in which the edge of this fluid curtain is possible.

0011]

[Means for Solving the Problem] This purpose is attained by the mode of a claim 1 and a claim 2.

0012] According to this invention, it is proposed that the edge fluid which has larger viscosity than that of this compound for coating is distributed in the form of a channel on the occasion of the guide of the descending curtain. This channel flows down this horizontal guide so that it may fall without the slowdown effect of a solid horizontal guide generating a unsteady flow. The hanging connection between a curtain and a horizontal guide is improved by this measure. The disturbance in the edge of this curtain which happens in the case of the edge fluid of hypoviscosity decreases.

0013] Preferably, this edge fluid was buried in this curtain (embedded). Being distributed on this horizontal guide is good so that it may run by the linear method of a laminar flow. When it puts in another way, it is that the free surface of this channel of an auxiliary fluid covers the overall height of descent, and is surrounded by the compound for coating of this curtain. The contact angle on this curtain electrode holder of this auxiliary fluid is also surrounded with this curtain fluid in this way. It guarantees that this way (embedding) of burying forms neither the loop to which this channel moves in a zigzag direction, nor deflection. This has an advantage in production of the charge of photograph material in which two or more layers carry out a laminating and by which they are usually simultaneously applied to this support. As for one with these individual layers, it is common that the reagent which soaks and has an operation is included. These are diffused in the channel of an auxiliary fluid. When these channels are not buried, these reagents that soak and have an operation help meandering of this channel, and spiral formation by the hysteresis of a contact angle. However, it was buried in this curtain and it turns out especially the channel that flows down this horizontal

guide by the linear method not only increases the hanging connection between a curtain and a horizontal guide, but that it has a stabilization effect to disturbance.

[0014] It is advantageous that this edge fluid has the viscosity of one 2 to 4 times the size of this compound for coating of this. When this curtain consists of two or more layers which have the various flowing characteristics, it can prevent effectively weakening this measure on this curtain with this edge, and giving an operation and disturbance.

[0015] It is convenient by injecting this edge fluid into this compound for coating during this curtain formation that this channel is made. In this way, this edge fluid is supplied individually preferably here, and, thereby, distribution of this auxiliary fluid in the inside of the form of a channel can be hung down also by the technical more easy method.

[0016] The channel with few capacity flows than 40ml/m which can be preferably set up within the limits of per minute 10 to 35ml beforehand is desirable. The narrow channel which this curtain makes it buried along with total descent height by this method can be formed.

[0017] The silver-halide sensitive emulsion for photographs (photographic silver-halide emulsions) contains water, and it is also desirable that this edge fluid is formed by the water-soluble fluid (water-soluble fluid) exceeding 50 mPa-s which has the viscosity of 50 mPa-s-200 mPa-s preferably since it has viscosity usually smaller than 50 mPa-s.

[0018] It is desirable that this fluid consists of the water-soluble polymer compound (water-soluble polymer compound) which has the viscosity between 50 mPa-s and 200 mPa-s here. This edge fluid is easy to make.

[0019] As for a **** edge fluid, it is desirable that the copolymer (maleic acid-methylvinylether copolymer) of polyvinyl alcohol (polyvinyl alcohol), a polyvinyl pyrrolidone (polyvinyl-pyrrolidone), and the maleic-acid-methyl vinyl ether and a butadiene maleic-acid copolymer (butadiene maleic acid copolymer) are included. These starting materials (starting substances) are commercialized and are easily available. It is possible to use the glycerol (glycerol) of the Newton type fluid with extremely high cost-performance (Newtonian fluid) for **** edge fluids.

[0020] In the design of this equipment for curtain coating, this discharge means includes the means which makes a channel, the means made this edge fluid flow down each horizontal guide in the form of a channel, and the viscosity of this edge fluid is over the viscosity of this compound for coating.

[0021] In order that sliding-surface type car sting equipment (sliding surface casting device) may make this channel, when being used structurally, it is the crossing edge of the sliding surface of this sliding-surface type car sting equipment, and recommends using edge piece (nozzle-like end piece) like the nozzle which injects this edge fluid into this compound for coating. Also in the case of knockout car sting equipment (extrusion casting device), this structural design for supply of this edge fluid is recommended. It is possible to make the channel which flows down this horizontal guide linearly in this way by the easy method within well-known coating equipment.

[0022] In order to make it advantageous, this edge fluid is added in each horizontal guide by the desirable method fewer than 40ml/m of adjusting by the per minute 10 - 35ml capacity flow. By this method, in the case of the curtain coating which uses the car sting solution for photographs, this channel can be designed so that this car sting solution may make this channel buried along with total descent height.

[0023] Since it has preferably deviation equipment which deflects the edge beside this curtain together with this edge fluid before this curtain hits this support, it is good that only the amount of [of this curtain] center section carries out the coat of this support. This prevents that an edge fluid reaches this support. The phenomenon in which can carry out the coat of the base like a web, and it becomes thick with an edge to this edge with a photosensitive car sting solution is not seen at all.

[0024] In seven examples, Table 1 showed the effect of the various edge fluids of the various flowing characteristics in the experimental curtain car sting (curtain casting) equipment of drawing 1. As for this curtain, three layers of the silver-halide sensitive emulsion for photographs were formed in all these examples of an experiment, and descent height became 15cm, and the capacity

low of this edge fluid was supplied by injection with an edge in the amount of 35ml/m by each horizontal guide. It of the one side top layer whose viscosity of two bottom layers located toward his support is 40 mPa-s is 30 mPa-s.

[0025] The technical effect of this edge fluid supply that depends on this invention is estimated by the so-called detached building limitation (break-offlimit). This detached building limitation is the possible minimum capacity flow (the minimum possible volume flow of the fluid curtain) of a curtain and the fluid curtain with which the hanging connection during a horizontal guide (hanging connection) is maintained in addition. If fluid speed decreases further, this curtain will separate from the soffit of this horizontal guide. This curtain is converged. Coating is already then impossible. The various edge fluids in which this fluid speed is cut down starting with the stable curtain, and threshold value ** of this detached building limitation, i.e., this coating process, has the various flowing characteristics were described by the example of Table 1 in this way. This detached building limitation was shown by Table 1 in m²/s. This value corresponds to the capacity flow standardized by car sting width of face and the unit of time (casting width and time unit). It is here and is [0026].

[Equation 1]

$$10^{-6} \frac{m^2}{s} \hat{=} 10^{-2} \frac{cm^2}{cm \cdot s}$$

[0027] It comes out.

[0028] It is first shown by comparison of Example 1 and Example 2 that it is possible to decrease this detached building limitation by supply of the fluid for flashes (flushing fluid) so that it may be well-known with supply of the edge fluid of hypoviscosity, therefore the conventional technology.

[0029] If the viscous edge fluid of this invention which flows in the form of a channel buried in this curtain is used, a clearly good result can be attained. This detached building limitation decreased in the half substantially by this invention as compared with the conventional technology (Example 2) as illustrated even in Examples 3-7. If it puts in another way, by the time the hanging connection of a between [this curtain and a horizontal guide] leaves the capacity flow by which this fluid curtain was standardized, it can decrease from 150cm³/cm-s to 76cm³/cm-s of threshold value (Examples 4-7).

[0030] this invention makes it possible to attach a very thin fluid film to this support.

[0031] The behavior of the flow of this edge fluid also makes it make it viscous structurally so that it may be illustrated in Examples 4 and 7. The viscosity of these edge fluids exceeds 100 mPa-s without stress (without stress).

[0032]

[Example] With reference to a below attached drawing, this invention is explained in detail in the form of a desirable instantiation-example.

[0033] The equipment for curtain coating (device for curtain coating) which depends on this invention is illustrated by the whole perspective diagram by drawing 1. The feeder 14 is shown here as sliding-surface car sting equipment which makes the descent curtain (falling curtain) 3 from the compound for fluid coating. This curtain descends exceeding the descent height 30 from the CARS theine grip (casting lip) 23 of this sliding-surface car sting equipment, and carries out the coat of the support 2. This support is guided with the car sting roller 1, and is continuously conveyed in the direction of a path 28 through the coating range 31. The descent curtain 3 is guided by the horizontal guide 5 with a flank edge. These horizontal guides are extended to the point that this curtain hits this support exceeding the total descent height 30 from the surrounding upper limit 26 of this CARS theine grip 23. The means 10 for making the channel 9 of the edge fluid 8 has, and is in each transection edge 12 of this sliding surface 29. This edge fluid is supplied by the discharge means 7, and discharge into this compound for coating is brought about by edge piece 11 like a nozzle. This edge fluid is made to take out each discharge means 7 from this edge piece 11 so that it can adjust about a capacity flow, and may be buried with the edge 6 of this curtain 3 and it may flow down this

horizontal guide 5 at a laminar-flow ceremony. This edge fluid is deflected by deviation equipment 19 (not shown in detail) by the soffit of this horizontal guide 5 so that it may be illustrated by drawing 1. In a drawing, the width of face 21 of this coating 4 is shorter than the width of face 22 of this support 2. This compound for coating forms the pile layer 18 which comes out of the car sting slot 25, and flows down this sliding surface 29 so that it may be illustrated in the partial notching view of this curtain 3. This edge fluid is injected into this pile layer 18 so that it may illustrate in detail to drawing 2.

[0034] Drawing 2 is the cross section of the curtain coating equipment in alignment with line II-II of drawing 1. Edge piece 11 like a nozzle injects this edge fluid into the pile layer 18 which consists of the individual layers 15, 16, and 17, as this example shows. Each car sting solutions of these for layers come out of the car sting slot 25 which is connected at the distributor channel 24 and the transport device (not shown) in each case. The car sting solution which comes out of each car sting slot 25 is piled up on the sliding surface 29 toward which this feeder 14 inclined, and forms the pile layer 18. The edge fluid injected into this pile layer 18 at this transection edge forms a channel on this curtain electrode holder, and the aforementioned channel has a uniform cross section at a laminar-flow ceremony, and progresses to it from this upper limit 26 to a soffit 27. it is illustrated by drawing 2 -- as -- the thickness of this curtain 3 -- the height of this descent -- increasing -- while -- decreasing. The channel 9 of the edge fluid 8 which can set up the capacity flow beforehand possible [regulation] here covers the overall height of this descent, and is stopped by the fluid of a descent curtain. Making this channel 8 buried in this way is illustrated still in detail by the following drawing.

[0035] Drawing 3 is the detail drawing of the horizontal guide taken along with line III-III of drawing 1. The structure with a flat horizontal guide of having the channel 9 which flows down it is shown here, and the aforementioned channel 9 is completely stopped by the edge 6 of this curtain 3. As shown in an enlarged view, the contact angle of this channel covers the overall height of descent, and is surrounded by the compound for fluid coating of this curtain 3. On the other hand, making this channel 9 buried with this appearance guarantees that the slowdown effect of this solid-state curtain electrode holder 5 is reduced. Convergence of this curtain in this edge field is prevented in this way. On the other hand, this edge fluid 8 guides this fluid curtain that flows at a straight-line ceremony and consists of this pile layer 18. Here, the shearing viscosity (shearing viscosity) of this edge fluid 8 is larger than each layers 15 and 16 of this pile layer 18, or that of 17. This edge fluid can be deflected with deviation equipment (deflecting device) 19 by the soffit of this horizontal guide. However, what is also sucked up together with this edge fluid only by the edge of this coating following this completion of coating on this base (sucked away) is possible. This is shown by drawing 4 which illustrates the portion of drawing 1 with an enlarged view.

[0036] This edge fluid is supplied by the discharge means 7 which is a means for making this channel 10 from the nozzle 11 which forms an injection flow on this sliding surface so that drawing 4 and drawing 1 may show. Moreover, naturally this nozzle 11 can also inject this edge fluid around a different position 23, for example, a CARS theine grip. It is also possible to discharge a hyperviscous edge fluid from outlet opening in a ***** guide (not shown in drawing). In this case, this horizontal guide forms this discharge means. In this way, the aforementioned horizontal guide is structurally designed so that formation of the channel on this curtain electrode holder may be easy-ized, and so that the viscosity of this channel fluid may become larger than the viscosity of this compound for coating.

[0037] Drawing 1 and the sliding-surface car sting equipment illustrated by 2 and 4 are desirable instantiation-examples. Moreover, naturally this fluid curtain can also be formed by the knockout (extrusion).

[0038]

[Table 1]

例	エッジ流体	離れ限度 (Break-off limit) $10^{-6} \text{ m}^2/\text{s}$	粘度 $\text{mPa} \cdot \text{s}$
1	なし	175	∞
2	水	150	1
3	ポリビニルアルコール (polyvinyl alcohol)	88	200 (ニュートニアン (Newtonian))
4	ポリアクリルアミド (Polyacryl amide)	76	構造的に粘性あり (structurally viscous)
5	ブタジエンコポリマー (Butadiene copolymer)	76	55 (ニュートニアン (Newtonian))
6	グリセロール (Glycerol)	76	140 (ニュートニアン (Newtonian))
7	セルロース誘導体 (Cellulose derivative)	76	構造的に粘性あり (structurally viscous)

[0039] It will be as follows if the feature and mode of this invention are shown.

[0040] 1. In Method for Carrying Out Curtain Coating of Support by Compound for Fluid Coating of at Least One Layer (Fluid Coating Composition) The process which forms process in which this support is moved along the path passing through a coating field, and the curtain, with which the compound for fluid coating which crosses this path of this support and is extended descends, By the horizontal guide (lateral guide) over which the edge fluid which has larger viscosity than the viscosity of this compound for coating is distributed upwards in the form of a channel (channel) (distributed) The method for carrying out curtain coating of the support by the compound for fluid coating of at least one layer characterized by providing the process which guides the descending this curtain.

[0041] 2. Method characterized by this channel flowing down each horizontal guide in method of the above 1 by method of laminar flow of straight line buried in this curtain.

[0042] 3. Method characterized by viscosity of this edge fluid being 2 to 4 times size of viscosity of this compound for coating of this in the above 1 or method of 2.

[0043] 4. Method characterized by making this channel in method of the above 1-3 by injecting this edge fluid into this compound for coating during formation of this curtain.

[0044] 5. It is the method characterized by this channel carrying the desirable capacity flow which it can be fewer than 40ml/m, and can be adjusted, and in which per minute 10 - 35ml regulation is possible in the method of the above 1-4.

[0045] 6. It is the method characterized by being formed by the water-soluble fluid (water-soluble fluid) by which this edge fluid has the viscosity between 50 mPa-s and 200 mPa-s in the method of the above 1-5.

[0046] 7. Method characterized by this fluid being water-soluble polymer compound (water-soluble polymer compound) in method of the above 6.

[0047] 8. Method characterized by this edge fluid containing polyvinyl alcohol (polyvinyl alcohol), polyvinyl pyrrolidone (polyvinyl pyrrolidone), maleic-acid-methyl-vinyl-ether copolymer (maleic acid-methyl-vinylether copolymer), and butadiene maleic-acid copolymer (butadiene maleic acid copolymer) in method of the above 1-5.

[0048] 9. Method characterized by this edge fluid being glycerol (glycerol) in method of the above 1-6.

[0049] 10. A transportation means to convey support along the path (28) passing through a coating field, The feeder which makes the descent curtain (3) which crosses this path of this support, and is

extended, and descends on this support from the compound for fluid coating (14), The horizontal guide which guides this descent curtain in a horizontal edge (6) (5), In the equipment for having a discharge means (7) to distribute an edge fluid, on this horizontal guide, and carrying out curtain coating of this support (2) by this compound for fluid coating of at least one layer This discharge means (7) has the means (10) for making a channel. The means (10) is making this edge fluid flow down each horizontal guide in the form of a channel (9). The viscosity of this edge fluid (8) is equipment for carrying out curtain coating of the support by the compound for fluid coating of at least one layer characterized by being larger than the viscosity of this compound for coating.

[0050] 11. This ** for making a channel in the equipment of the above 10 is equipment with which each means (10) is characterized by making it flow down this horizontal guide by the method of a laminar flow of the straight line buried in this curtain (3) in this edge fluid (drawing 3).

[0051] 12. It is equipment which the equipment of the above 11 sets and is characterized by for this feeder (14) being sliding-surface car sting equipment (sliding-surface casting device), and this means (10) that makes this channel having edge piece (nozzle-like end piece) (11) like the nozzle in the crossing edge (12) of the sliding surface (sliding-surface) (29) of this sliding-surface car sting equipment.

[0052] 13. It is equipment characterized by for this feeder being knockout car sting equipment (extrusion casting device) in the equipment of the above 11, and having edge piece like the nozzle which this means for making this channel is the crossing edge of this knockout slot (extrusion slot), and injects this edge fluid into this compound for coating.

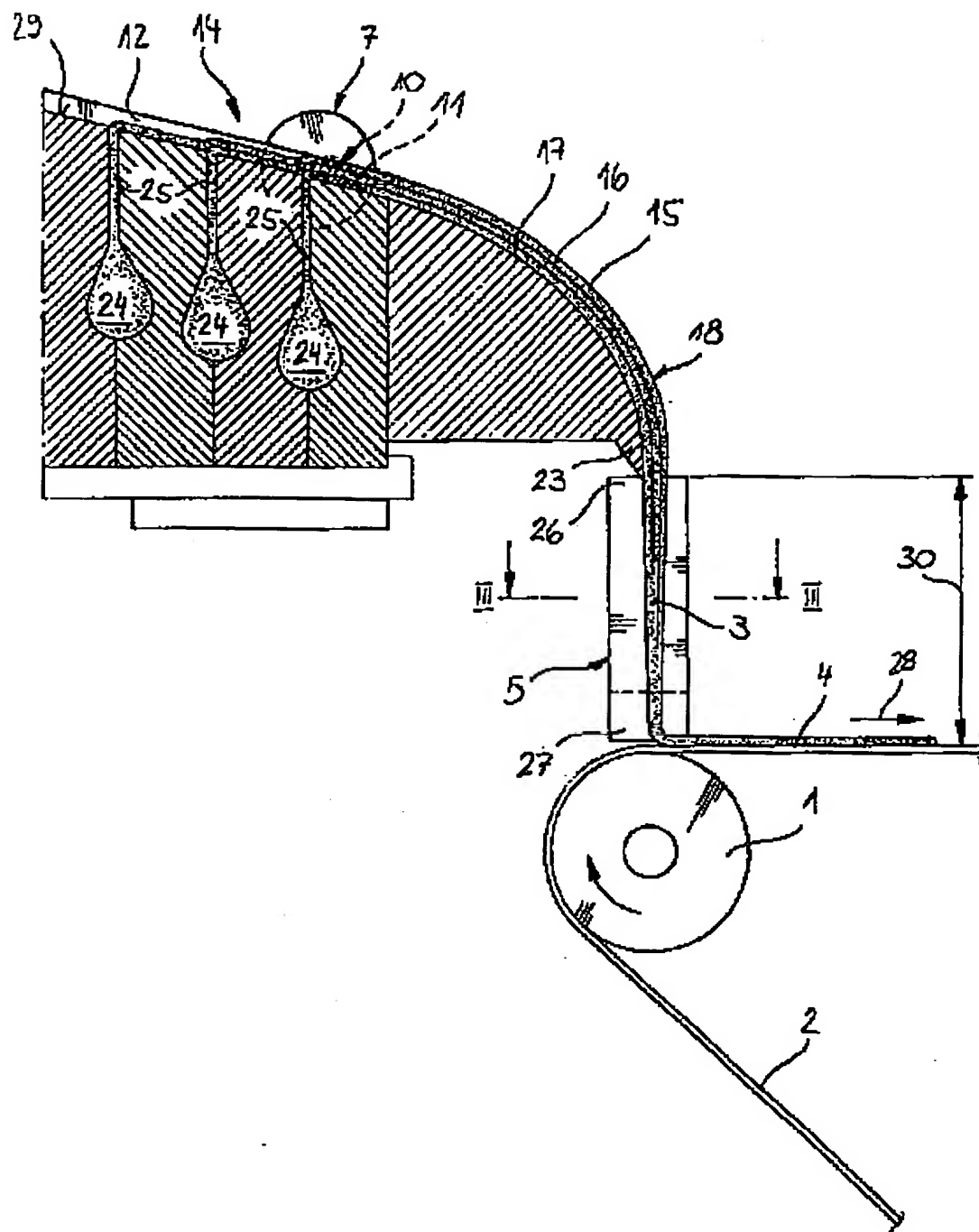
[0053] 14. It is equipment characterized by this discharge means (7) emitting this edge fluid on each horizontal guide (5) in the equipment of the above 11-13 by the desirable capacity flow fewer than 40ml/m in which per minute 10 to 35ml regulation is possible.

[0054] 15. This Horizontal Guide is Having between Separated in Equipment of above 10-14, so that Width of Face (21) of this Curtain May Become Smaller than Width of Face (22) of this Support. And before this curtain hits this support, deviation equipment (19) is arranged on each horizontal guide. The deviation equipment (19) is equipment which is made to deflect this horizontal edge (6) of this curtain together with this edge fluid (8), and is characterized by only the amount of [of this curtain] center section carrying out the coat of this support.

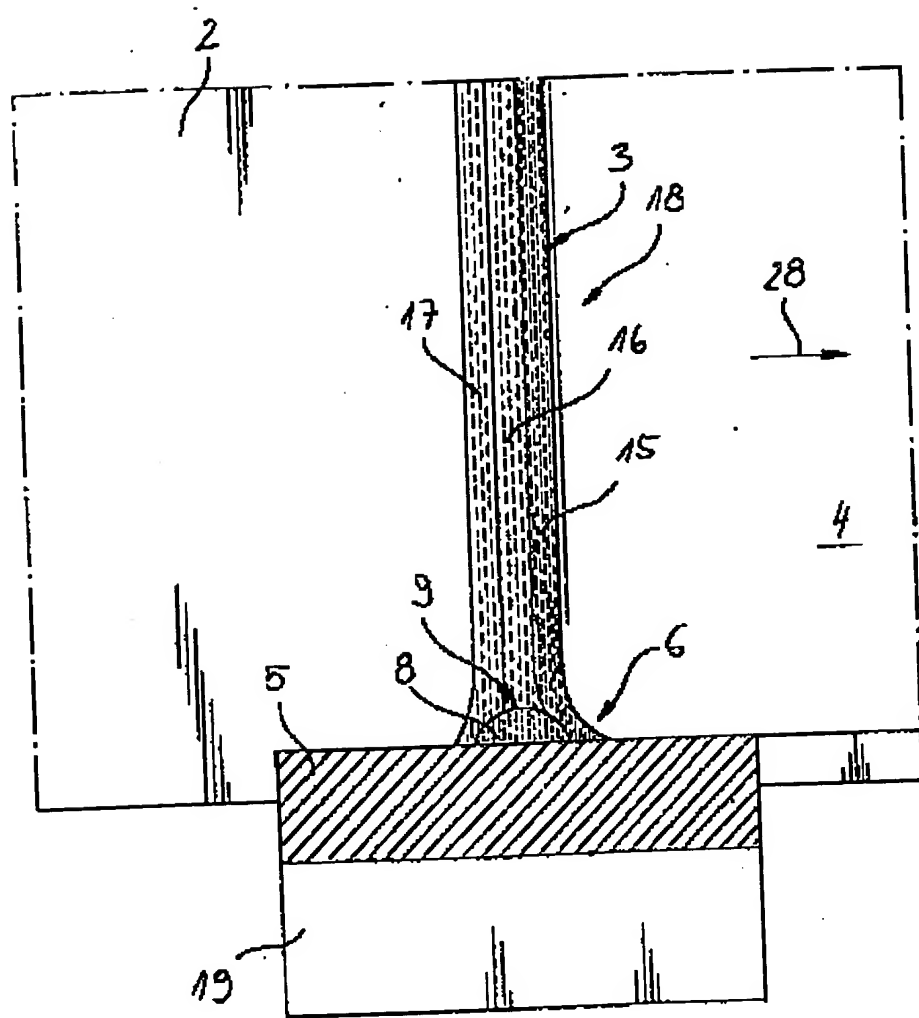
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Drawing 1



Drawing 2



Drawing 3

